

What Is Claimed Is:

1. A tunable Fabry-Perot filter comprising:
a bottom mirror mounted to the top of a substrate;
a bottom electrode mounted to the top of said
bottom mirror;
a thin membrane support atop said bottom
electrode;
a top electrode fixed to the underside of said
thin membrane support;
a reinforcer fixed to the outside perimeter of
said thin membrane support; and
a confocal top mirror set atop said thin membrane
support, with an air cavity being formed between said
bottom mirror and said top mirror;
and with said thin membrane support being in the
form of a dome with openings therein, with said
openings being small enough, and with sufficient
distance therebetween, so as to substantially not
affect the overall structural integrity of said dome,
while still allowing chemical access to the region
inside the dome.

2. A tunable Fabry-Perot filter according to claim 1 wherein said substrate comprises a semiconductor material.

3. A tunable Fabry-Perot filter according to claim 1 wherein said bottom mirror and said top mirror comprise distributed Bragg reflectors.

4. A tunable Fabry-Perot filter according to claim 3 wherein said distributed Bragg reflectors comprise alternating layers of quarter-wavelength thick deposited dielectric films.

5. A tunable Fabry-Perot filter according to claim 4 wherein said dielectric films are fabricated from the group consisting of Si; Al_2O_3 ; SiO_2 ; TiO_2 ; MgO ; Ta_2O_5 ; zirconium oxide; or any combination thereof.

6. A tunable Fabry-Perot filter according to claim 1 wherein said openings comprise circular holes.

7. A tunable Fabry-Perot filter according to claim 1 wherein said thin membrane support is formed

from a material selected from the group consisting of silicon nitride and titanium-tungsten (TiW).

8. A tunable Fabry-Perot filter according to claim 1 wherein said bottom mirror is planar and said top mirror is curved, so as to form, between said mirrors, a confocal stable resonator.

9. A tunable Fabry-Perot filter according to claim 8 wherein said confocal stable resonator has a well-defined near-Gaussian mode structure.

10. A tunable Fabry-Perot filter according to claim 8 wherein said top mirror has a radius of curvature, said radius of curvature being optimized such that said mode size of said cavity matches the size of the core of an optical fiber.

11. A method for making a tunable Fabry-Perot filter, said method comprising the steps of:

- (a) providing a substrate;
- (b) forming a bottom mirror on the top surface of said substrate;

(c) forming a bottom electrode on the top surface of said bottom mirror;

(d) depositing a sacrificial structure on the top surface of said bottom electrode;

(e) etch-masking said sacrificial structure so as to leave an inwardly sloped perimeter edge on said sacrificial structure;

(f) depositing a top electrode on said sacrificial structure;

(g) depositing a thin membrane support on top of said sacrificial structure, said top electrode and a portion of said bottom electrode, said thin membrane support being in the form of a dome;

(h) depositing a reinforcer onto said thin membrane support such that said reinforcer covers the sloped perimeter edge of said sacrificial structure and extends inwardly thereof, adjacent to and parallel to the top surface of said sacrificial structure, and outwardly thereof, adjacent to and parallel to the upper surface of said bottom electrode;

(i) etch-masking openings through said thin membrane support, the openings being formed small enough, and with a sufficient distance therebetween, so

as to substantially not affect the overall structural integrity of the dome, while still allowing chemicals to be introduced into the region inside the dome;

(j) selectively depositing a top mirror onto the center of said thin membrane support, inboard of the reinforcer; and

(k) selectively removing said sacrificial structure through said openings using an etching technique.

12. A method according to claim 11 wherein said bottom mirror is planar and, subsequent to step (k), said top mirror is curved, so as to form, between said mirrors, a confocal stable resonator.

13. A method according to claim 11 wherein said sacrificial structure is formed from a material selected from the group consisting of polyimide and aluminum.

14. A method according to claim 11 wherein said sacrificial structure is in the form of a circular disk.

15. A method according to claim 11 wherein said central structure is in the form of a polygon.

16. A method according to claim 11 wherein said thin membrane support is formed from a material selected from a group consisting of silicon nitride and titanium-tungsten (TiW).

17. A method according to claim 11 wherein said reinforcer is formed from a material selected from the group consisting of silicon nitride or a metal.

18. A method according to claim 11 wherein said etching technique comprises dry etching.

19. A method according to claim 11 wherein said bottom and top mirrors comprise distributed Bragg reflectors.

20. A method according to claim 11 wherein the material of said mirrors is selected from the group

consisting of Si; Al₂O₃; SiO₂; TiO₂; MgO; Ta₂O₅; zirconium oxide; or any combination thereof.

21. A method according to claim 11 wherein said sacrificial structure is formed of polyimide and said etching is accomplished with oxygen plasma.

22. A method according to claim 11 wherein said sacrificial structure is formed of aluminum and said etching is accomplished using CF₄ plasma.

23. A tunable laser comprising:

a substrate;

a bottom mirror mounted to the top of said substrate;

a gain region mounted to the top of said bottom mirror;

a bottom electrode mounted to the top of said gain region;

a thin membrane support atop said bottom electrode;

a top electrode fixed to the underside of said thin membrane support;

a reinforcer fixed to the outside perimeter of said thin membrane support; and

a confocal top mirror set atop said thin membrane support;

with an air cavity being formed between said bottom mirror and said top mirror;

and with said thin membrane support being in the form of a dome with openings therein, with said openings being small enough, and with sufficient distance therebetween, so as to substantially not affect the overall structural integrity of the dome, while still allowing chemicals to be introduced into the region inside the dome.

24. A tunable laser according to claim 23 wherein said substrate comprises a semiconductor material.

25. A tunable laser according to claim 23 wherein said bottom and top mirrors comprise distributed Bragg reflectors.

26. A tunable laser according to claim 25 wherein said distributed Bragg reflectors comprise alternating

layers of quarter-wavelength thick deposited dielectric films.

27. A laser according to claim 26 wherein said dielectric films are fabricated from the group consisting of Si; Al_2O_3 ; SiO_2 ; TiO_2 ; MgO ; Ta_2O_5 ; zirconium oxide; or any combination thereof.

28. A tunable laser according to claim 23 wherein said openings comprise circular holes.

29. A tunable laser according to claim 23 wherein said thin membrane support is formed from a material selected from the group consisting of silicon nitride and titanium-tungsten (TiW).

30. A tunable laser according to claim 23 wherein said bottom mirror is planar and said top mirror is curved, so as to form, between said mirrors, a confocal stable resonator.

31. A tunable laser according to claim 30 wherein said confocal stable resonator has a well-defined

near-Gaussian mode structure.

32. A tunable laser according to claim 30 wherein said top mirror has a radius of curvature, said radius of curvature being optimized such that said mode size of said cavity matches the size of the core of an optical fiber.

33. A method for making a tunable laser, said method comprising the steps of:

- (a) providing a substrate;
- (b) forming a bottom mirror on the top surface of said substrate;
- (c) forming a gain region on the top surface of said bottom mirror;
- (d) forming a bottom electrode on the top surface of said gain region;
- (e) depositing a sacrificial structure on the top surface of said bottom electrode;
- (f) etch-masking said sacrificial structure so as to leave an inwardly sloped perimeter edge on said sacrificial structure;

(g) depositing a top electrode on said sacrificial structure;

(h) depositing a thin membrane support on top of said sacrificial structure, said top electrode and a portion of said bottom electrode, said thin membrane support being in the form of a dome;

(i) depositing a reinforcer onto said thin membrane support such that said reinforcer covers the sloped perimeter edge of said sacrificial structure and extends inwardly thereof, adjacent to and parallel to the top surface of said sacrificial structure, and outwardly thereof, adjacent to and parallel to the upper surface of said bottom electrode;

(j) etch-masking openings through said thin membrane support, the openings being formed small enough, and with a sufficient distance therebetween, so as to substantially not affect the overall structural integrity of the dome, while still allowing chemicals to be introduced into the region inside the dome;

(k) selectively depositing a top mirror onto the center of said thin membrane support, inboard of the reinforcer; and

(1) selectively removing said sacrificial structure through said openings using an etching technique.

34. A method according to claim 33 wherein said sacrificial structure is formed from a material selected from the group consisting of polyimide and aluminum.

35. A method according to claim 33 wherein said sacrificial structure is in the form of a circular disk.

36. A method according to claim 33 wherein said sacrificial structure is in the form of a polygon.

37. A method according to claim 33 wherein said thin membrane support is formed from a material selected from the group consisting of silicon nitride and titanium-tungsten (TiW).

38. A method according to claim 33 wherein said reinforcer is formed from a material selected from the group consisting of silicon nitride or a metal.

39. A method according to claim 33 wherein said etching technique comprises dry etching.

40. A method according to claim 33 wherein said bottom and top mirrors comprise distributed Bragg reflectors.

41. A method according to claim 40 wherein the material of said mirrors is selected from the group consisting of Si; Al_2O_3 ; SiO_2 ; TiO_2 ; MgO ; Ta_2O_5 ; zirconium oxide; or any combination thereof.

42. A method according to claim 33 wherein said sacrificial structure is formed of polyimide and said etching is accomplished with oxygen plasma.

43. A method according to claim 33 wherein said sacrificial structure is formed of aluminum and said etching is accomplished using CF_4 plasma.